SYSTEMATICS OF FISSION FRAGMENT TOTAL KINETIC ENERGY RELEASE

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Studies of the systematic behavior of the most probable total kinetic energy release in fission, $\langle E_K \rangle$, have shown that the data can be rather accurately described by a simple model based on Coulomb repulsion between prolate spheriods.[1] Such a model predicts that $\langle E_K \rangle$ depends linearly on the Coulomb parameter, $Z^2/A^{1/3}$, of the fissioning nucleus. It is expected that this relationship should describe liquid drop fission energetics, i.e. fission well-above the barrier. Since the dependence of $\langle E_K \rangle$ on excitation energy is rather weak, such a fitting procedure succeeds relatively well for spontaneous fission also.

Stimulated by two recent reports of $\langle E_K \rangle$ data at the lower[2] and upper[3] extremes of $Z^2/A^{1/3}$, a new evaluation of fission energy systematics has been performed. A weighted least-squares fit to the current data base[4] yields the following result:

$$\langle E_K \rangle = (0.1189 \pm 0.0011)\ Z^2/A^{1/3} + 7.3\ (\pm 1.5)\ \text{MeV}. \quad (1)$$

In performing these fits, a single value of $\langle E_K \rangle$ was entered for each fissioning nucleus; where several reported values of $\langle E_K \rangle$ existed, a weighted average of these was used. Also included in the data base were results for spontaneous fission, although $\langle E_K \rangle$ values for excited nuclei usually lie 1-2 MeV higher than for the fission of nuclei in their ground state. The χ^2 value per point for the fit is 1.54. In Fig. 1 the experimental data are compared with Eq. (1) and the prediction of Ref. 1. It is clear that Eq. (1) provides a significant improvement in the description of the data.

In summary, a re-evaluation of the dependence of $\langle E_K \rangle$ values on $Z^2/A^{1/3}$ yields a somewhat steeper slope previously used. This relationship (Eq. (1)) thus serves as a more general estimate of the most probable kinetic energy release in fission and fission-like phenomena than that of Ref. 1, particularly for very light or very heavy systems. In addition excellent agreement with fission kinetic energy release values predicted by the liquid drop model is observed.

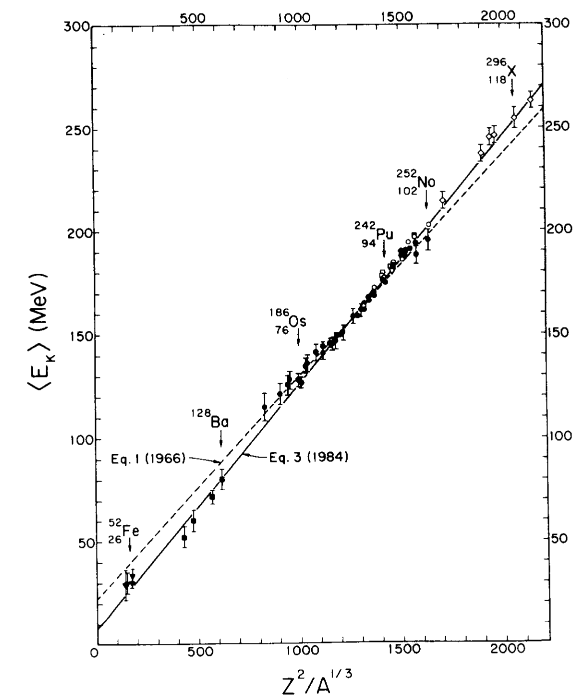

Figure 1. Plot of $\langle E_K \rangle$ values versus $Z^2/A^{1/3}$ of fissioning nucleus. Solid line represents Eq. (1) and dashed line Ref. 1.

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